Bacteriological quality of mechanically deboned chicken meat products

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Abstract

Mechanically deboned poultry meat is considered one of the most important nutrients due to their content of high-quality protein and some important elements such as selenium and iron. Therefore, the bacteriological qualities of some mechanically deboned chicken meat products sold in Ismailia city were investigated. A total of 100 minced chicken meat and chicken burger samples were subjected to be bacteriological analyzed. All samples of minced meat and chicken burger were positive (100%) for the presence of total psychrophilic count, and enterobacteriaceae, meanwhile it was positive for the presence *of E. coli* by 60% and 24% of minced meat and chicken burger respectively, The mean value of total psychrophilic count, enterobacteriaceae and *E. coli* in minced meat samples were 8.9 x 10^5, 5.6 x 10^5and8.5 x 10^2cfu/g. While, the mean value of total psychrophilic count, enterobacteriaceae and *E. coli* were 1.3 x 10^6, 6.8 x 10^4 and 3 x 10^2cfu/g for chicken burger samples. All samples were negative from hazards of salmonella. Some of mechanically deboned chicken meat products traded at Ismailia markets was unfit for human consumption due to exceed the permissible limits set by Egyptian standard

Introduction

Food habits of society have substantially changed due to rapid urbanization and hurried way of living, resulting in increased demand for ready to cook meat products. Consumers have become more selective, conscious of quality, concerned about value for money, freshness and health aspects of meat food products ***(Selvan et al, 2007)***.

Poultry meat is an important human food item in most countries due to its contribution in solving the problem of animal protein shortage. Its consumption continues to increase with a change in buying behavior and consumption attitudes from whole carcass to cut-up parts and further processed poultry products ***(Mielnik et al, 2002 and Perlo et al, 2006).***

One of the most important chicken meat products in the markets is chicken burger which is mainly manufactured from mechanically deboned chicken meat (MDCM). It is a paste-like meat product produced by forcing chicken under

high pressure through a sieve or similar device to separate the bone from the edible meat tissue. It is sometimes called "white slime" as an analog to pink slime ***(Groeger, 2012).***

The practices of mechanically harvesting leftover meat scraps date to the 1950s when mechanical hand tools were developed to help remove the remaining pieces of meat and connective tissue from animal carcasses to minimize waste. By the 1960, machines do this more efficiently. This allowed companies to use previously wasted materials and sell the derived meat products to the public for a lower price. During the 1970, these techniques became more common in other parts of the world, as well. In addition to poultry slaughterhouses, newcomers entered the market as they recognized the financial gains that mechanically separated meat processing allowed. During the 1950s, mechanically separated meat (MSM) was mostly used as a raw material for the production of many meat products**.** MSM is considered more perishable than fresh and minced meat ***(Viuda-Martoset al, 2012)***. During deboning process, microbial growth on the products is high ***(Hecer and Sözen, 2011).***

Regarding to the significant importance of presence of some microbial groups in mechanically deboned chicken meat; the poultry meat products could be spoiled and considered of low quality due to incidence of contamination by some microorganisms such as psychrophiles, which may produce a variety of odour and flavor defects. On the other side, these products are exposed to be contaminated by pathogenic microbes causing food-borne illness such as *salmonella* and *Escherichia coli*.

Therefore, the present study was undertaken to evaluate the bacteriological quality of mechanically deboned chicken meat collected from different markets in Ismailia city.

Material and Methods

Sample Collection: 50 samples from each of frozen minced chicken meat and chicken burger (each of 500g) were randomly collected from different sources, stores and supermarkets located in Ismailia city, Egypt. Sterile techniques were used during samples collection, packaging and microbiological analysis. Samples were transferred in ice-box to the laboratory where they were subjected to bacteriological analysis.

Sample Preparation *(APHA, 2002):* The samples were kept in frozen state till performance of analysis and protected in aluminum sheet against sunlight. Defrosting was performed in refrigerator at 4ºC for 12- 18 hours.25 gm of each sample transferred into a high duty plastic stomacher bag containing 225 ml sterile 0.1 % (w/v) buffered peptone water where it homogenized using a Stomacher 400 Lab Blender (Seward Medical, London, UK) for 2 minutes to

obtain a 1:10 dilution. 1 ml from original dilution was transferred into a series of sterile test tubes containing 9 ml of 0.1% sterile Buffer Peptone Water to prepare a decimal serial dilution of up to 10^6.

Enumeration of Total Psychrophilic Count *(APHA, 2002):* One ml of diluted sample was transferred into plate count agar using pour plate technique, and incubated at 7ºC for 10 days. Plates contain colonies between 30 - 300 were counted and multiplied with the rate of dilution, and expressed as CFU/g.

Enumeration of Enterobacteriaceae *(Nero, et al. 2006):* The number of enterobacteriaceae was determined by3M™ petri film™ technique. The top layer was lifted to expose the plating surface, and with a pipette, 1ml of the diluted sample was added. The top film is then slowly rolled down and the "spreader" was used for even distribution. It took a minute for gelling to occur. Incubation was at 35±2°C for 2-3 days. The colonies appeared pink to red with various size and shapes according to individual species. Counted colonies expressed as CFU/g.

Enumeration of *E. coli (APHA, 2002):* Total *E. coli* count was carried out by pour plate method on MacConkey agar and incubated for 18 – 24 hours at 35 ±ºC. *E. coli* produced pink to red colonies; the colonies were counted and expressed as CFU/g.

Detection of Salmonella *(APHA, 2002):* 10 ml of pre-enrichment sample were transferred into 90 ml Rappaport-Vassiliadis broth, and incubated for 24 hours at 42ºC. A loopful from the enrichment broth was streaked onto Salmonella-Shigella (S-S) agar and incubated at 37ºC for 24 hrs. The suspected colonies appeared small colorless to pale yellow, with or without black center. Three suspected isolated colonies similar to *Salmonella spp.* were picked and subjected to identification by biochemical tests.

Results and Discussion

Chicken meat products especially which manufactured from mechanically deboned chicken meat are liable to be contaminated with various kinds of spoilage and pathogenic microorganisms from different sources. Such contamination may render the products unsafe to consumer or impair its quality. The results achieved in table (1) showed the incidence of different bacterial groups among the mechanically deboned chicken meat samples. The positive numbers of minced chicken meat samples for psychrophiles, enterobacteriaceae group, *Escherichia coli* and *salmonella*, were 50(100%), 50(100%), 30(60%) and 0(0%) respectively. Meanwhile, the positive numbers of chicken burger for psychrophiles, enterobacteriaceae group, *Escherichia coli* and *salmonella*, were 50(100%), 50(100%), 12(24%) and 0(0%) respectively.

Psychrophilic Microorganisms: The statistical analytical results of total psychrophilic counts of chicken minced meat and chicken burger were recorded in table (2). The mean value of total psychrophilic count in chicken minced meat was8.9 x 10^5cfu/g with a minimum value of< $10^2$and a maximum value of 2.9 x 10^6cfu/g. The mean value of total psychrophilic count in chicken burger was 1.3 x 10^6cfu/g with a minimum value of< 10^2 and a maximum value of 4.7 x 10^6cfu/g.

The Egyptian Organization for Standardization and Quality Control ***(EOS, 2005)*** are set a limit 10^5cfu/g as acceptable limits for total aerobic count in MDCM. According to these permissible limits which recorded in table (3), 30(60%) out of 50 samples of minced chicken meat and 25 (50%) out of 50 chicken burger samples were acceptable for the human consumption, meanwhile 20 (40%) out of 50 samples of minced chicken meat and 25 (50%) out of 50 chicken burger samples were unfit for human consumption due to exceed the standard limits.

Similar results were obtained by ***Pipova et al (1997)*** who revealed that MDPM contained psychrophilic count between 10^4and10^7cfu/g.In additions**,** ***Whitman and Marshall (1971)*** showed psychrophilic count of greater than 2.2 x 10^5cfu/g. The results obtained in this study were definitely lower than results obtained by ***Mast and Stephens (1972)*** who recorded psychrophilic count between 108- 1010cfu/g.High numbers of psychrotrophic bacteria more than (10^5cfu/cm²) are required on poultry surfaces before off-flavors, off-odors and appearance defects are able to be detected organoleptically. Researchers have reported that higher numbers of bacteria 3.2x10^7 to 1x10^9cfu/cm² were required to produce slime than were needed for odor to become noticeable ***(Russell et al, 1995 and Vasut & Robeci, 2009).***

Psychrophilic bacteria have the ability to grow at 0°C with a maximum temperature for growth at 20°C or below. The microbial group is widespread in the environment where it contaminates food especially refrigerated meat products. Psychrophilic bacteria are found in water, soil, and dirty equipment and can grow under chilled conditions, especially in nutrient rich media such as mechanically separated meat ***(Gomes et al, 2003).*** It found on the chicken skin surface and unable to multiply significantly, as long as, this skin is kept dry and intact ***(Barnes, 1976).*** The psychrophilic count serves in predicting the shelf-life of a food or product in cold storage. They have value in assessing both of the safety and quality of the products.

Total Enterobacteriaceae Count: The statistical analytical results of total enterobacteriaceae counts of chicken minced meat and chicken

burger were recorded in table (3). The mean value of total enterobacteriaceae count in chicken minced meat was 5.6 x 10^5cfu/g with a minimum value of < $10^2$and a maximum value of 8.8 x 10^5cfu/g where, the mean value of total enterobacteriaceae count in chicken burger was 6.8 x 10^4cfu/g with a minimum value of < $10^2$and a maximum value of 1.4 x 10^5cfu/g.

It is well known that enterobacteriaceae count was generally considered to be suitable indicator for fecal contamination of coliform or, indicator of possible enteric contamination in the absence of coliforms ***(Mercuri and Cox, 1979).*** Similar results were obtained by ***Bijker, et al (1987)*** who recorded results of10^4 to 10^5cfu/g. ***Saad (2011)*** who achieved T.E.C. of 5.08 x 10^4cfu/g in fried chicken pattie. The prevalence rates of enterobacteriaceae found by ***Kozačinski, et al (2006)*** were 21.05% % of analyzed samples of ground chicken meat which is lower than reported in this study result (85%).

Enterobacteriaceae is used in food testing as hygiene indicator organisms and can give advance warning of failures in hygiene procedures in your food manufacturing site. Enterobacteriaceae present at the time of slaughter or introduced by workers and their cutting tools, or through water and air during dressing, evisceration, cutting and cooling ***(Ayres et al, 1980).***

Total *E. coli* Count: The statistical analytical results of *E. coli* counts of chicken minced meat and chicken burger were recorded in table (4). The mean value of total *E. coli* count in chicken minced meat was 8.5 x 10^2cfu/g with a minimum value of < $10^2$and a maximum value of 3 x 10^3cfu/g. The mean value of total *E. coli* count in chicken burger was 3 x 10^2cfu/g with a minimum value of < $10^2$and a maximum value of 2 x 10^3cfu/g.

Several studies determined the *E. coli* count in chicken meat such as ***Maxey et al (1973)*** which reported a relatively similar result between 10 and 10^3cfu/g.Lower results were obtained by ***Kilonzo-Nthenge et al (2013)*** revealed that *E. coli* count of 4.94 log10cfu/g.Higher results were achieved by ***Eman and Sherifa (2012)*** which was 3×10^4cfu/g.

The incidence rates found by ***Altabari and AL-Dughaym (2002)*** were 70% of the samples minced chicken meat. Regarding to ***SASO (1998)*** *E. coli* counts should be less than 102cfu/g. in chicken meat. It is widely accepted that presence of *E. coli* is an indicator of fecal contamination ***(Brown and Baird-Parker, 1982; FSANZ, 2005 and Levy et al, 2007).***

E. coli is one of the food-borne pathogens that may be associated with poultry and implicated in human illness. There were 12 confirmed cases of*E.coli*O157:H7 and nine others with suggestive

symptoms who could not be confirmed. It is unable to pinpoint the source of the *E. coli* whether it came from a particular food product, food handling or a combination of both. Most of the persons who got sick ate hamburgers and laboratory tests for *E. coli* O157:H7 detected the bacteria on some samples of ground beef patties.

These organisms are present in the intestinal tract of carriers and hence are excreted in the feces. Poultry meat and its products may be contaminated by infected food handlers who practice poor personal hygiene or by contact with water contaminated by human sewage. They also added that the intestinal tract of chicken is an important reservoir of *E. coli.* Hence the meat may be contaminated by this organism through fecal contact during slaughter ***(ICMSF, 1996).***

Detection of Salmonella: In this study, the suspected salmonella strains was isolated from the examined samples by conventional cultures methods, meanwhile confirmation test failed to confirmed the salmonella. *Salmonella species* are important zoonotic pathogens that cause gastrointestinal disease in humans and animals. Poultry products contaminated with these pathogens are one of the major sources of human Salmonella infections ***(Desin et al, 2013).*** According to ***WHO (1994)***, the salmonella infections of food animals play an important role in public health and particularly in food safety. Also, one of the predominant food-borne pathogens associated with poultry and are frequently implicated in human illness ***(Corry and Atabay, 2001; Antunes et al., 2003 and CDC, 2006)*** which subjected to condemnation if suspected.

In conclusion, the chicken products under study which manufactured from mechanically deboned chicken meat were carrying a wide range of microorganisms at different levels. These organisms have great significant in regard to the public health and safety of chicken meat products. Some of mechanically deboned chicken meat products traded at Ismailia markets was unfit for human consumption due to exceed the permissible limits set by Egyptian standard.

Table 1: *Incidence of Bacterial Groups in MDCM Samples (n=100)*

	Minced chicken meat N=50		**Chicken burger N=50**	
	Positive No. (%)	**Negative No. (%)**	**Positive No. (%)**	**Negative No. (%)**
Psychrophiles	50(100)	0(0)	50(100)	0(0)
Enterobacteriaceae	50(100)	0(0)	50(100)	0(0)
E. coli	30(60)	20(40)	12(24)	38(76)
Salmonella	0(0)	50(100)	0(0)	50(100)

Table 2: *Statistical Analytical Results for Total Psychrophilic Counts (CFU/g) in MDCM*

Samples	**MDCM**	
	Minced meat	**Chicken burger**
Minimum	$<10^2$	$<10^2$
Maximum	$2.9x10^6$	$4.7x10^6$
Mean	$8.9x10^5$	$1.3x10^{6*}$
S.E.	$\pm 2.4x10^5$	$\pm 3.4x10^5$

S.E. means standard error

Table 3*: Statistical Analytical Results for Total Enterobacteriaceae Counts (CFU/g) in MDCM*

Samples	**MDCM**	
	Minced meat	**Chicken burger**
Minimum	$<10^2$	10^4
Maximum	$8.8x10^5$	$1.4x10^5$
Mean	$5.6x10^5$	$6.8x10^4$
SE	$\pm 6.5x10^4$	$\pm 8.2x10^3$

Table 4: *Statistical Analytical Results for Total Escherichia coli Counts (CFU/g) in MDCM*

Samples	**MDCM**	
	Minced meat	**Chicken burger**
Minimum	$<10^2$	$<10^2$
Maximum	$3x10^3$	$2x10^3$
Mean	$8.5x10^2$	$3x10^2$
SE	$\pm 2x10^2$	$\pm 1.3x10^2$

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الجودة البكتريولوجية للحوم الدواجن المنزوعة العظم ميكانيكيا

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الملخص العربي

تعتبر لحوم الدواجن المنزوعة العظم ميكانيكيا من المواد الغذائية الهامة نظرا لاحتوائها على بروتين حيواني عالي الجودة و بعض العناصر الهامة مثل السلينيوم و الحديد. لذلك تم فحص عدد مائة عينة من لحم الدجاج المفروم وبرجر الدجاج بواقع خمسين عينة من كل منتج مجمعة عشوائيا من الأسواق لأجل تقييم الجودة البكتريولوجية لتلك المنتجات و أسفرت الدراسة ان عينات لحوم الدجاج المفرومة وبرجر الدجاج إيجابية بنسبة ١٠٠ % لوجود كل من البكتيريا المحبة للبرودة و بكتيريا الإمعائيات. وكانت إيجابية لنفس العينات بنسبة ٦٠% و ٢٤% لمجموعة البكتيريا الإشريكية القولونية على الترتيب. ولم تتمكن الدراسة من عزل ميكروب السالمونيلا فى العينات تحت الدراسة. وأظهرت النتائج أن متوسط العدد الكلى للبكتريا المحبة للبرودة، مجموعة الإمعائيات و العدد الكلى للبكتيريا الإشريكية القولونية فى عينات لحم الدجاج المفروم هى ٨,٩ × ١٠^٥، ٥,٦ ×١٠^٥ و٨,٥ × ١٠^٢ على التوالي بينما كانت النتائج فى عينات برجر الدجاج هى ١,٣ × ١٠^٦، ٦,٨ × ١٠^٤ و ٣ × ١٠^٢ على التوالي. هذا وتمت مناقشة النتائج المتحصل عليها وإعطاء التوصيات اللازمة التي من شأنها رفع الجودة البكتريولوجية لتلك المنتجات أثناء التخزين والتداول.